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COMMITTEE ON THE PEACEFUL USES
OF OUTER SPACE
Scientific and Technical Subcommittee
Twenty-ninth session
Agenda item 5

IMPLEMENTATION OF THE RECOMMENDATIONS OF THE SECOND UNITED NATIONS CONFERENCE ON THE PEACEFUL USES OF OUTER SPACE

Agreement on joint activities in the study and utilization of outer space, signed on 30 December 1991 by the States members of the Commonwealth of Independent States

The States Parties to this Agreement,

Noting the great significance of space science and technology for the development of the States members of the Commonwealth,

Recognizing the need to combine efforts for the effective study and utilization of outer space in the interests of the national economy and of science, as well as to ensure defensive capacity and to guarantee the collective security of the States members of the Commonwealth,

Affirming the need for strict compliance with the inter[illegible]al agreements and obligations previously entered into by the USSR in the area of the study and utilization of outer space,

Considering that the adoption of the Agreement on joint activities in the study and utilization of outer space will serve the interests of its signatory States,

Have agreed on the following:

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Article 1

Joint activities in the study and utilization of outer space shall be carried out by the States Parties to this Agreement on the basis of inter-State programmes.

Article 2

The implementation of the inter-State programmes for the study and utilization of outer space shall be coordinated by the Inter-State Space Council, composed of plenipotentiary representatives of the States Parties to this Agreement, and the Council's statute shall be ratified by a decision of the heads of Government.

The States Parties to this Agreement may have independent programmes for the study and utilization of outer space.

Article 3

The conduct of inter-State programmes for the study and utilization of outer space in the area of space assets of a military and dual (military and civilian) kind shall be undertaken by the joint strategic armed forces.

Article 4

The inter-State programmes for the study and utilization of outer space shall be financed by means of assessed contributions from the States Parties to this Agreement and shall be based at existing and recently established space centres and facilities (the "Baikonur" and "Plesetsk" space centres, technical, launching and landing complexes, landing areas for separated components of launch vehicles, flight control centres for space vehicles, astronaut training centres, control and instrumentation facilities, information compilation and processing points, arsenals and other facilities).

The use of this infrastructure for the conduct of independent programmes by the States Parties to this Agreement shall be determined by separate agreements between the parties concerned.

Article 5

Expenditure on the utilization of existing, and the creation of new, space systems intended to serve the national economy or scientific and military purposes and on the maintenance of the unique test facilities, as well as any profits received from space projects and space vehicle launches carried out on a commercial basis, shall be shared among the States Parties to this Agreement in accordance with their assessed participation.

The States Parties to this Agreement shall be liable for their activities in the study and utilization of outer space under conditions and a regime to be determined by special agreement.

Article 6

The States Parties to this Agreement undertake to organize their activities in the study and utilization of outer space in accordance with the existing norms of international law and to coordinate their efforts aimed at resolving problems under international law related to the study and utilization of outer space.

Article 7

The States Parties to this Agreement undertake to accept the mutually agreed decisions determining the regime of their prorated participation in financing inter-State programmes in the study and utilization of outer space, the provision of facilities, areas of land, material and energy resources, the payment of compensation for damage connected with the use of space technology, as well as the regime for the denunciation of this Agreement by one or all States Parties.

Article 8

The States Parties to this Agreement undertake to provide the individuals and facilities involved in the conduct of inter-State programmes in the study and utilization of outer space with the necessary material and technical resources, to offer privileges in the area of State regulations and taxation, as well as to resolve questions of social security.

In the determination of State budgets, they undertake, with effect from 1992, to make provision for the allocation of the necessary resources for the implementation of inter-State programmes.

Article 9

The States Parties to this Agreement undertake to carry out the specialized training of qualified experts in their higher education systems, in scientific research institutes and in their academies of science, in order to provide trained professional staff for space infrastructure facilities.

Article 10

The States Parties to this Agreement shall take no decisions and shall perform no actions leading to the violation (the obstruction) of the normal functioning of space facilities and centres situated on their territories.

They undertake to preserve and to develop the existing technological and production potential for the planning, creation, testing and processing of rocket and space technology within the context of the inter-State programmes that have been adopted.

Article 11

With the consent of the States Parties to this Agreement, other States may also accede to it.

Article 12

The Agreement shall enter into force on the date of its signature.

DONE in the city of Minsk on 30 December 1991 in one original copy in the official languages of the States Parties to this Agreement.

The original copy shall be kept in the archives of the Government of the Republic of Belarus, which shall send authenticated copies of this Agreement to the States Parties.

For the Republic of Armenia
L. TER-PETROSIAN

For the Republic of Azerbaijan
A. MUTALIBOV

For the Republic of Belarus
S. SHUSHKEVICH

For the Republic of Kazakhstan
N. NAZARBAEV

For the Republic of Kyrgyzstan
A. AKAEV

For the Russian Federation
B. YELTSIN

For the Republic of Tajikistan
R. NABIEV

For Turkmenistan
S. NIYAZOV

For the Republic of Uzbekistan
I. KARIMOV

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COMMITTEE ON THE PEACEFUL USES OF OUTER SPACE
Scientific and Technical Subcommittee
Twenty-ninth session
Agenda item 7

USE OF NUCLEAR POWER SOURCES IN OUTER SPACE

Working paper submitted by the Russian Federation

It is generally accepted that in order to solve the problem of radiological safety of spacecraft carrying nuclear power sources (NPSs), it is important to study collisions of spacecraft carrying NPSs with space debris. The radiological consequences of such collisions are determined by the altitude of the NPS-carrying spacecraft's orbit, the circumstances of the collisions, the mechanisms of disintegration of the NPS, the possibility of descent from orbit and the aerodynamic disintegration of the NPS or its components on descent through the atmosphere.

Bearing in mind the view of the Subcommittee regarding the need for further investigation of the problem of collisions between NPSs and space debris and for publication of the results of such investigations, the Russian Federation is submitting a working paper giving the preliminary results of calculations carried out in 1991 as part of the Federation's overall programme to investigate the safety of space NPSs.

The paper considers possible collisions with space debris by the nuclear power reactors (NPRs) launched into space between 1970 and 1988 and located in 700-1,000 km orbits (see the working paper by the USSR of 26 February 1990, A/AC.105/C.1/WG.5/L.24/Add.2).

Collision conditions (velocity, angle) were selected for the collision of a fuel element assembly with space debris in the form of steel fragments with a mass of 0.25 kg and a linear dimension of 4 cm, and with a mass of 1.4 kg and a linear dimension of 7 cm. A study was made of the numerical modelling of a one-dimensional impact load applied to the laminated structure of a fuel element assembly consisting of 37 cylindrical fuel elements with annular

beryllium reflectors and uranium-molybdenum alloy fuel pellets. The fuel elements were fixed in a housing which also contains components of the drive mechanism for ejecting the fuel element assembly from the reactor vessel. The impact of a 0.25 kg fragment with a velocity of 7 km/sec and of a 1.4 kg fragment, with a velocity of 1 km/sec on the steel components of the drive mechanism in the fuel element assembly was calculated. The initial parameters for the trajectory of the fuel element assembly before the collision were taken from data for the COSMOS-1900 and COSMOS-1932 satellites.

The collision of a fuel element assembly with a 0.25 kg fragment may be expected to lead to disintegration of the fragment and the steel components of the drive mechanism into particles of the order of 20 micrometres in size. The fuel element assembly with the housing will continue in flight after being subjected to a retarding impulse of 47 m/sec. In the case of collision of a fuel element assembly with a 1.4 kg fragment, the fragment, the drive mechanism components, and to some extent the housing and the end portions of the fuel elements may be expected to disintegrate into particles of the order of 20 micrometres. The individual fuel elements will continue in flight after being subjected to a retarding impulse of 28 m/sec. The retarding impulses for the fuel element assembly and for an individual fuel element are calculated in accordance with the direction cosines of the velocity vector of the fuel element assembly's flight path at the time of the collision.

The change in flight trajectory parameters and the lifetime of the objects after the collision (see table) were calculated for two models of the atmosphere: GOST 25645.115-84, which applies in the Russian Federation, and CIRA-86 with average solar activity indices of F 10.7 = 106 and a geomagnetic perturbation index of Kr = 2.667. The ballistic coefficients of the objects after the collision are 503 kg/m^2 for the fuel element assembly with the housing and 116 kg/m^2 for an individual fuel element.

With a minimal lifetime of the objects after the collision of more than 100 years, the activity in the reactor fuel will be determined by the caesium 137 content, and amounts to:

For the fuel element assembly - lifetime 450 years and activity 0.0017 curie;

For an individual fuel element - lifetime 200 years and activity 0.015 curie.

Thus, the objects after the collision - a fuel element assembly with housing and individual fuel elements - will, with aerodynamic dispersion occurring in the dense layers of the atmosphere, present practically no radiation danger to individual members of the population or to the environment. The only possible consideration would be chemical pollution of the soil by uranium and beryllium, the level of pollution by which is determined by the aerodynamic disintegration of the fuel element assembly structure and of individual fuel elements.

Entry of the fuel element assembly and of individual fuel elements into the atmosphere after the collision will result in disintegration of the steel casings of the fuel elements and the housing at altitudes of 88-87 km, accompanied by release of the fuel pellets and the annular beryllium reflectors. The subsequent free fall of the fuel pellets ends with their melting in the altitude range 86-85 km, with the formation of an extended particle source 150 km long. Calculation of the further movement of the fuel particles and the change in their dimensions by the Monte Carlo method, taking into account fragmentation of the melted material, evaporation and the chemical reactions of the uranium with the oxygen in the air, yield a probable particle spectrum with final dimensions in the 60-880-micrometre range deposited at altitudes of 64-18 km, with an overall ballistic extent of the cloud of around 400 km along the descent trajectory.

The fuel particle distribution by size is described by a logarithmic normal law, which yields an average size of 225 micrometres. The maximum density of particle fallout is 40 g/km^2 for a mass in the fuel element assembly of 30 kg of uranium 90 per cent enriched with uranium 235. The surface contamination of the soil with uranium, 0.04 mg/m^2, can yield a volume content in the cultivated soil layer of not more than 0.2 mg/m^3, insignificant in comparison with the natural uranium content of the soil, which is of the order of 1.5 g/m^3.

Aerodynamic disintegration of the annular beryllium reflectors, whose total mass is 4.15 kg, takes place at altitudes of 77-67 km over a section of the trajectory 200 km long. The probable range of final particle sizes is 1.175-8.83 mm for an altitude of 77 km and 0.615-3.32 mm for an altitude of 67 km. The density of beryllium fallout at the earth's surface will not exceed 0.05 mg/m^2, which corresponds to a volume content in the cultivated soil layer of 0.5 mg/m^3, and is lower than the natural beryllium content in the soil, which is estimated as being at the 4 g/m^3 level.

Thus, fallout of particles of toxic materials from a fuel element assembly (uranium and beryllium) following aerodynamic disintegration will not have chemical consequences.

Subsequent studies of issues involving the collision of NPSs with space debris are aimed at developing computer software for two-dimensional impact loading at high collision velocities in combination with analytical engineering methods. This will afford more realistic numerical modelling of collisions, a reduction in the computer time spent on calculations and a substantial increase in the number of simulations, among which simulations of collisions with radiological and chemical consequences are not excluded.

Lifetime of objects without collision and after collision

Initial orbit of fuel element assembly, km		Lifetime of fuel element assembly without collision, years		Mass of fragment, kg	Impact velocity km/s	Retarding impulse, m/s	Object after collision	Life after collision, years	
Apogee	Perigee	Atmosphere GOST 25695-115-84	Atmosphere CIRA-86					Atmosphere GOST 25695-115-86	Atmosphere CIRA-86
765	718	1 000	1 200	1.4	1.0	20	Individual fuel element	250	200
977	937	10 300	10 000	1.4	1.0	20	Individual fuel element	2 300	2 200
765	718	1 400	1 200	0.25	7.0	47	Fuel element assembly with housing	600	450
977	937	10 500	10 000	0.25	7.0	47	Fuel element assembly with housing	7 000	6 500

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COMMITTEE ON THE PEACEFUL USES
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Twenty-ninth session
Agenda item 15

OTHER MATTERS

Report on the protection and preservation of the outer space environment, especially activities potentially affecting the Earth environment

Working paper submitted by Poland

1. At the thirty-fourth session of the Committee on the Peaceful Uses of Outer Space, held at Graz, Austria, in May-June 1991, the Committee took note of the working paper submitted by Poland containing a report on the protection and preservation of the outer space environment, especially activities potentially affecting the Earth environment (A/AC.105/L.190). Several countries expressed their support for the idea contained in the working paper.

2. Knowing the activity of the Scientific and Technical Subcommittee on the subject in question, particularly the long-term work devoted to the space debris problem (e.g., the report on "Environmental effects of space activities" (A/AC.105/420) and other documents), Poland would like to request the Subcommittee to consider the proposal to establish a working group to elaborate the above-mentioned report.

3. Taking into consideration working paper A/AC.105/L.190 of 27 May 1991, the working group could establish the final list of problems which should be included in the report and could select experts, institutions or agencies helpful in the elaboration of the items contained in the report.

4. The working group could act also as an editorial committee in the final shaping of the report.

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5. Representatives of States which are most active in space research, such as the United States of America, the Commonwealth of Independent States, China, France, Germany and Japan, should be invited to the working group. It would be advisable also to invite the authors of document A/AC.105/420, Dr. S. J. Bauer and Dr. L. Perek, as the experts with a remarkable experience in the field of the environmental effects of space activities.